1985

Evaluation of Seasonal Habitat Use By White-Tailed Deer in Eastern South Dakota

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EVALUATION OF SEASONAL HABITAT USE BY WHITE-TAILED DEER IN EASTERN SOUTH DAKOTA

BY

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A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science
Major in Wildlife and Fisheries Sciences (Wildlife Option)
South Dakota State University
1985

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This thesis is approved as a creditable and independent investigation by a candidate for the degree, Master of Science, and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

ACKNOWLEDGEMENTS

I would foremost like to thank my advisor, Dr. Thomas R. McCabe for his support, insight, encouragement, and friendship during the project.

I wish to thank D. Haukos, J. Stander, H. Drews, K. Peterson, T. Schneider, K. McPhillips, and all the other people who provided me with unlimited help throughout the project.

All or parts of the manuscript were reviewed by Drs. T. R. McCabe, L. D. Flake, and K. F. Higgins, all of whom provided valuable criticisms. I also wish to thank Dr. R. L. Linder for providing logistic support and Dr. W. L. Tucker who made valuable suggestions for statistical analysis.

I am very grateful to my wife Susan and to my parents for their unwaivering support and assistance.

Funding was provided by Federal Aid to Wildlife Restoration Fund. Project W-75-R in South Dakota, and the South Dakota Agricultural Experiment Station (S-913), through the South Dakota Cooperative Wildlife and Fisheries Research Unit (U.S. Fish and Wildlife Service, South Dakota Department of Game, Fish and Parks, South Dakota State University, and the Wildlife Management Institute, cooperating).

PREFACE

The thesis is presented in 3 sections so that the separate research questions can be more clearly amplified. Chapter 1 contains a literature review of previously published research conducted on white-tailed deer (Odocoileus viginianus) which is pertinent to the overall scope of my research. In addition, this chapter defines the research problems. Chapter 2 discusses the results of seasonal deer use of various habitats on a study area in east-central South Dakota determined from radio telemetry monitoring. Results of seasonal deer trail counts conducted on the study area are presented in chapter 3. Use of trail counts to determine habitat use was compared with data obtained from telemetry observations to verify whether the technique was suitable for use in South Dakota.

TABLE OF CONTENTS

LIST OF TABLES

EVALUATION OF SEASONAL HABITAT USE BY WHITE-TAILED DEER IN EASTERN SOUTH DAKOTA

ABSTRACT

THOMAS J. KRAMLICH

Seasonal use of selected habitat types by white-tailed deer (*Odocoileus virginianus*) was investigated using radio telemetry locations during 1983 and 1984, on a predominantly agricultural area in east-central South Dakota. In the summer of 1983, radio-collared deer used corn, shelterbelts, and wetlands in proportion to their availability. Soybeans, grainfields, and grasslands were avoided. Deer selected shelterbelts in the fall and wetlands during the winter months, for protective cover. Habitat use shifted in the spring and shelterbelts received heavy use, once they became free of drifted snow. Shelterbelts continued to be selected by deer during the summer of 1984. In the fall of 1984, both corn and shelterbelts were selected. Deer habitat use also was determined from seasonal deer trail surveys conducted on the study area in spring, summer, and fall of 1984. When compared to radio telemetry data for verification, significant differences ($P < 0.05$) were detected in use patterns for the spring and fall seasons.

CHAPTER 1

LITERATURE REVIEW

White-tailed deer _(Odocoileus virginianus)_ populations have been increasing in agricultural areas throughout eastern South Dakota according to South Dakota Deptartment of Game, Fish, and Parks data. The economic importance of the deer herd in this region has also been increasing. During the period 1980 through 1984 the number of gun hunting licenses for deer sold and the number of deer harvested quadrupled. In 1980, 10,020 licenses were issued and hunters harvested an estimated 6,731 deer. By 1984 the number of licenses issued had increased to 38,749 and hunters harvested an estimated 27,924 deer. Eastern South Dakota currently supports a valuable deer resource but continued growth of this herd will lead to greater resource-landowner conflict.

Crop damage by deer can be a serious problem since deer feed on a wide variety of domestic crops and can cause losses to farmers. Landowner demands to reduce crop depredations, can be an important factor determining regulation of deer population levels in farmland areas (Carter 1973, Larson et al. 1978, Ludwig 1981, Gladfelter 1981, Teboldi 1982). Richardson and Petersen (1974) felt that landowner tolerance was a key factor in maintaining deer populations in eastern South Dakota. Agriculture-deer conflicts may be intensified by the loss of suitable deer habitat, due to conversion of the land to agricultural uses.

Continued loss of wildlife habitat in farmland areas is a serious problem. Intensification of agriculture with the increased use of irrigation and large farm machinery has resulted in the elimination of noncultivated areas such as fencerows, shelterbelts, and wetlands (Burger 1978). Drainage of wetlands in eastern South Dakota has been extensive and is continuing (Ruwaldt 1975, Desjardins 1985). Less then half of the wetlands that once existed in the prairie pothole region still remain (Harmon 1970).

Sparrow and Springer (1970) reported that wetlands and riparian woodlands were important wintering areas for deer in east-central South Dakota. Harmoning (1976) studied deer dispersion in North Dakota and found that deer traveled long distances to wintering areas composed of predominantly wooded cover. Petersen (1984) reported that shelterbelts and marshes were important to deer in intensively farmed areas because they provided the only available cover.

Agricultural land also receives seasonal use by deer (Sparrow 1966, Aalgard 1973, Harmoning 1976, Herron and Rongstad 1982). Farm crops, such as corn and alfalfa, provide deer with abundant food and cover during the summer and fall. After the harvest, crop residues are heavily used by deer throughout the winter months. Corn has been reported to be one of the most important food items for deer throughout the Midwest (Mustard and Wright 1964, Watt et al. 1967, Dorn 1970, Nixon et al. 1970, Pils et al. 1981). Both Watt et al. (1967) and Nixon et al. (1970) reported that in agricultural areas browse was not an important component in the diet of white-tailed deer. Deer will persist in feeding on farm crops even when natural browse is available (Dahlberg and Guettinger 1956). Murphy (1968) felt that deer in the Midwest were not food limited because of the availability of waste grain throughout the winter. Nixon et al. (1970) agreed, but thought the availability of waste grain may be reduced if current farming practices, such as fall plowing, became more prevalent in the future.

At the present time more information is needed on seasonal habitat use patterns of white-tailed deer in relation to land use types. In order for deer managers to effectively manage deer populations in agricultural areas, criteria other than deer crop damage complaints are needed. There is a need to identify critical seasonal habitats in order to increase efficiency of management efforts and heighten public awareness of the value of these areas.

Pellet-group counts have been widely used by biologists to measure deer use or preference of different habitat types (Neff 1968). However, this technique assumes that pellet-groups are deposited in all habitats at a constant rate. Recent work by Collins and Urness (1979) seriously questioned this assumption.

Use of deer trail counts to assess deer habitat use was first reported by McCaffery (1976) in Wisconsin. He reported that surveys run in the fall after a hard frost produced the most consistent results when compared to other methods. More recently McCaffery (1979) reported that training inadequacies of observers and poor sampling design produced erratic results from some surveys. However, surveys run by experienced biologists have continued to produce good results. The Wisconsin Department of Natural Resources has recently replaced pellet-group counts with trail counts as a technique for estimating deer populations and habitat use in some management units (Creed and Haberland 1980). Based on the findings from Wisconsin, trail counts could potentailly provide valuable information on deer habitat use in eastern South Dakota.

The availability of habitat use information would help wildlife personnel in their efforts to identify and evaluate existing deer habitat. The information could also be used to devise management strategies that would reduce agriculture-deer conflicts in the future. This study provides information on seasonal habitat use by white-tailed deer in eastern South Dakota. The primary objectives of this research were:

1. To determine seasonal patterns of white-tailed deer habitat use in relation to land use types in eastern South Dakota.
2. To test the validity of using trail counts as a method for determining relative deer use of various habitat types.

CHAPTER 2

WHITE-TAILED DEER HABITAT USE IN EASTERN SOUTH DAKOTA

White-tailed deer populations have dramatically increased in agricultural regions throughout eastern South Dakota since the drought period of the mid-1970's (South Dakota Dept. Game, Fish, and Parks). At the same time, the amount of traditional deer habitat such as shelterbelts and wetlands has been declining. (Walker and Suedkamp 1977, Desjardins 1985). Similar trends of stable or expanding deer numbers have been noted in agricultural areas across the midwest, even though forested habitat, such as woodlots and riparian woodlands has been decreasing at a rate of 1% to 3% per year, primarily due to conversion of these areas to agricultural use (Gladfelter 1984).

Continued loss of habitat may be contributing to growing agriculture-deer conflicts caused by deer crop depredations. Large numbers of deer are forced to concentrate in localized areas of suitable wintering habitat, where they may cause heavy damage to unharvested crops or livestock forage. The purpose of this investigation was to measure seasonal deer use of cropfields and non-agricultural habitat by monitoring radio-tagged deer on a regular basis. Percentages of radio locations in each habitat, each season, were used to determine which habitat types were being avoided or selected by deer.

STUDY AREA

The 9,330 hectare study area was located in Brookings and Lake counties in east-central South Dakota, 32 km southwest of the city of Brookings. This area lies within the Coteau des Prairie region and is typified by gently rolling hills interspersed with glacial wetlands. Climate of the area is continental with extremes in temperature ranging from 38 C in the summer to -29 C in the winter and having an average annual precipitation of 52.3 cm. The mean annual snowfall is 60.1 cm.

The study area was a matrix of agricultural and non-agricultural habitat types. Major crops included corn, cereal grains, soybeans, and hayfields, with non-cultivated areas being utilized as pasture for livestock production. Three state Game Production Areas and 7 federal Waterfowl Production Areas were interspersed throughout the area. Habitat in these areas consisted of prairie wetlands bordered by grassy uplands, which were maintained as nesting cover for gamebirds and waterfowl. Other habitats available include shelterbelts, abandoned farm sites, and lowland woody cover.

Agricultural land was classified into 3 general habitat types: 1) cornfields, 2) small grains and soybeans, and 3) grasslands. Grasslands included pastures, hayfields, alfalfa, and idle grass uplands. Idle croplands resulting from the Payment in Kind (PIK) program, were usually covered with a pioneering growth of weeds, forbs, and grasses, so were included in this catagory. Non-agricultural land was classified into 2 general habitat types: 1) shelterbelts and farmstead woodlots, and 2) wetlands. Wetlands included all marshes, non-cultivated, seasonally wet areas and lowland woody cover such as willow (Salix spp.) and cottonwood (Populus deltoides) trees and shrubs. Estimated deer density on the study area was determined by weekly observation, to be between 1 and 3 deer per square km (3-8 per square mile).

METHODS AND MATERIALS

Deer were captured on the study area from January 1983 through September 1984. Modified clover traps (Clover 1956) were used to trap deer during the winter of 1983. Thereafter, a Cap-chur gun (Palmer Chemical and Equipment CO., Douglasville,Georgia) fitted with a rifle scope, was used with succinylcholine chloride loaded darts (Pneu Dart Inc., Williamsport, PA.) to capture deer. Only yearling or adult deer were drugged. Does were fitted with color-coded radio collars containing a battery operated transmitter (Telonics Inc., Mesa AZ.). Bucks were tagged with a solar powered transmitter mounted on a cattle ear tag (Herron et al. 1982).

Locations of telemetered deer were collected using 2 double-yagi antenna systems that were vehicle-mounted. A null-peak combiner and 2 scanning receivers (Telonics Inc., Mesa AZ) were attached to the antennas. Data from 1983 were obtained using dual 2-element yagi antenna systems, which were each mounted in the bed of a pickup truck (Hallberg et al. 1974). Data from 1984 were obtained using 4-element yagi antennas (Advanced Telemetry Systems, Inc., Bethel MN) that were mounted through the roof of each truck. The first system was found to be impractical for collecting data during the winter months. Frequent cracking and breaking of the 2-element yagis was also a major problem. The 4-element antenna system proved to be more efficient and durable. Accuracy of the 2-element antenna systems were calibrated at $\pm$ 2.5 degrees ($P < 0.05$) up to a distance of 1.6 km using transmitters placed at known angles and distances. Accuracy of the 4-element systems were calibrated at $\pm$ 1.5 degrees ($P < 0.05$) using the same method.

Telemetry locations were collected from tagged deer during 4 time periods: morning (0600-1200), afternoon (1200-1800), evening (1800-2400), and late night (2400-0600). Telemetry observations were made on a regular basis during each of the 4 seasons: spring (22 March-21 June), summer (22 June-21 September), fall (22 September-21 December), and winter (22 December-21 March). In order to increase the accuracy of each telemetry location, 3 pairs of simultaneous fixes were taken from known positions, resulting in a series of 6 fixes being taken on each animal.

Telemetry azimuth data were manually plotted on clear plastic sheets overlaid on ASCS aerial photos. If an erroneous fix was observed it was deleted from the data. Remaining fixes for each deer location were then analyzed using the computer program TELEM. The TELEM program used all remaining fixes from each deer location to calculate an x y coordinate which represented the average location obtained from every combination of all possible pairs of fixes. Averaged locations were then plotted on the aerial photos.

Deer locations were pooled and analyzed for each season. Chi-square goodness of fit tests were used to determine if observed deer habitat use (proportion of radio locations in each habitat type each season) was different from the proportion of occurrence of the respective habitats on the study area. If significant differences were detected, avoidance or selection of individual habitats was determined by constructing confidence intervals around the proportion of observed use for each habitat type (Neu et al. 1974). Tests with $P \leq 0.05$ were considered significant.

Proportions of the different habitats available during the summer, fall, and winter 1983-84 were estimated from ASCS aerial photos, which were field verified in August and September. In the spring, summer, and fall of 1984, seasonal estimates of the available habitat were obtained by conducting transects through randomly chosen sections on the study area.

RESULTS

Percentage of the study area composed of the different habitats was variable between years. During the summer of 1983, corn comprised 26% of the area, soybeans and grains 15%, grasslands 45%, wetlands 11%, and shelterbelts 3%. In the summer of 1984, corn again comprised 26% of the area, soybeans and grains increased to 29%, grasslands dropped to 32%, wetlands 10%, and shelterbelts 3%.

Fourteen does and 4 bucks were captured and tagged with radio transmitters during 1983-84 (Table 1). Only deer that were relocated a minimum of 10 times were included in the habitat analysis. Radioed bucks dispersed from the study area soon after their capture. Both male white-tailed deer and dispersing female yearlings have previously been reported to travel long distances in the prairie farmland areas of North and South Dakota (Sparrow and Springer 1970, Aalgard 1973). One of the bucks, which was tagged as a yearling on 18 May 1984, was later harvested on 3 November in Lac Qui Parle County, Minnesota, 75 miles northeast of the capture site. A yearling female tagged on 20 May 1984 also disappeared soon after her capture. This animal was subsequently harvested on 19 November in Turner County, South Dakota, approximately 60 miles south of her capture site. Due to transmitter failure no data was obtained from 1 of the other collared does. Telemetry observations of the remaining 12 does yielded 391 locations from July 1983 to November 1984 (Table 2).

Table 1. Month of capture, sex, and number of relocations for 18 white-tailed deer radio-tagged on the study area in east-central South Dakota, 1983-84.

ID No.	Sex	Month of capture	No. of relocations
039	F	02/83	80
100	F	02/83	13
140	F	02/83	24
083	M	06/83	2
240	F	06/83	77
199	F	07/83	14
179	F	07/83	17
340	F	07/83	57
290	F	07/83	62
570	F	07/83	10
894	M	07/83	1
195	M	02/84	3
964	M	05/84	2
420	F	05/84	1
020	F	07/84	11
520	F	07/84	13
460	F	07/84	12
575	F	09/84	0

Number of telemetry locations in each habitat indicated that deer did not use all habitat types in proportion to their availability ($P < 0.05$) during any season (Table 2). Use of individual habitat types varied by season.

During the summer of 1983, deer began using cornfields when the crop was tall enough to provide cover for bedding and travel. Use of corn was high (39%), but deer utilized this habitat in proportion to its availability, as indicated by the 95% confidence interval (Table 3). Grasslands received regular use (27%) during the summer, although the use was mostly at night and less than the proportion of this habitat type that was available. Deer used both shelterbelts and wetlands in proportion to their occurrence during this season.

Increased use of wooded habitat by deer occurred during the fall of 1983, indicating a selection for shelterbelts. Wetlands continued to be used in proportion to their occurrence. Grasslands were the most heavily utilized agricultural habitat (40%) during this season and received frequent, but proportional use. Also, corn was used in proportion to its availability in the fall. Other crop types were avoided.

Deer concentrated during the winter. Harvested corn fields received frequent (31%), but proportional use. Other crops such as soybeans, grain stubble fields, and winter wheat were also used in proportion to their availability. Wetlands received their greatest use

Table 2. Proportional habitat composition and telemetry locations of white-tailed deer in east-central South Dakota, 1983-1984.

	Proportion of study area and number of deer radio locations											
Habitat type	Summer 1983		Fall 1983		Winter 1983-84		Spring 1984		Summer 1984		Fall 1984	
Corn	.26	26	.26	11	.26	24	.17	8	.26	21	.24	20
Soybeans and grains	.15	3	.15	4	.15	20	.15	11	.29	10	.29	5
Grasslands	.45	18	.45	25	.45	15	.55	21	.32	10	.40	7
Shelterbelts	.03	7	.03	13	.03	0	.02	29	.03	10	.01	9
Wetlands	.11	12	.03	10	.03	19	.11	11	.10	7	.06	5
Total Number locations		66		63		78		80		58		46
Chi-square	12.74* (d. f. = 4)		12.26* (d. f. = 4)		15.93* (d. f. = 4)		33.08* (d. f. = 4)		10.51* (d. f. = 4)		17.90* (d. f. = 4)	

* $P < 0.05$

Table 3. Seasonal habitat selection or avoidance (95% confidence interval) by radio-tagged white-tailed deer in east-central South Dakota, 1983-84.

Season	Habitat type	Proportion of study area	Proportion observed P_i	95% CI on proportion observed
Summer 1983	Corn	.26	.393	$.238 < P_1 < .548$
	Soybeans and grain	.15	.045a ~~.245a~~	$-.021 < P_2 < .111$
	Grasslands	.45	.272a	$.131 < P_3 < .413$
	Shelterbelts	.03	.106	$.008 < P_4 < .204$
	Wetlands	.11	.181	$.059 < P_5 < .303$
Fall 1983	Corn	.26	.174	$.051 < P_1 < .297$
	Soybeans and grains	.15	.063a	$.016 < P_2 < .142$
	Grasslands	.45	.396	$.237 < P_3 < .555$
	Shelterbelts	.03	.206b	$.075 < P_4 < .337$
	Wetlands	.11	.158	$.040 < P_5 < .276$
Winter 1983-84	Corn	.26	.307	$.177 < P_1 < .437$
	Soybeans and grains	.15	.256	$.133 < P_2 < .379$
	Grasslands	.45	.192a	$.081 < P_3 < .303$
	Shelterbelts	.03	.000	
	Wetlands	.11	.243[b]	$.122 < p_4 < .364$

a = avoidance (proportion of study area > upper confidence limit);

b = selection (proportion of study area < lower confidence limit).

Table 3. Continued.

Season	Habitat type	Proportion of study area	Proportion observed P_i	95% CI on proportion observed
Spring 1984	Corn	.17	.100	$.014 < P_1 < .186$
	Soybeans and grains	.15	.137	$.038 < P_2 < .236$
	Grasslands	.55	.262a	$.135 < P_3 < .389$
	Shelterbelts	.02	.362b	$.224 < P_4 < .500$
	Wetlands	.11	.137	$.038 < P_5 < .236$
Summer 1984	Corn	.26	.362	$.200 < P_1 < .542$
	Soybeans and grains	.29	.172	$.044 < P_2 < .300$
	Grasslands	.32	.172a	$.044 < P_3 < .300$
	Shelterbelts	.03	.172b	$.044 < P_4 < .300$
	Wetlands	.10	.120	$.010 < P_5 < .230$
Fall 1984	Corn	.24	.434b	$.246 < P_1 < .622$
	Soybeans and grains	.29	.108a	$.010 < P_2 < .226$
	Grasslands	.40	.152a	$.016 < P_3 < .288$
	Shelterbelts	.01	.195b	$.045 < P_4 < .345$
	Wetlands	.06	.108	$.010 < P_5 < .226$

a = avoidance (proportion of study area > upper confidence limit);

b = selection (proportion of study area < lower confidence limit).

(24%) and were selected by deer during the winter months. Shelterbelts quickly became filled with snow during December, and received little or no use until the following spring.

Wintering concentrations of deer disbanded in March and use of non-agricultural habitat increased. Shelterbelts were strongly selected (36%) during the spring season, while wetlands were used in proportion to their occurrence. Grasslands were the most heavily utilized agricultural habitat (26%), but the observed use was less than the proportion of this habitat type that was available.

During the summer of 1984, corn once again received heavy (36%) but proportional use. Grasslands were avoided and wetlands continued to receive proportional use. Deer utilized shelterbelts less frequently than in the spring, although they continued to be selected during the summer.

Cornfields were heavily utilized (43%) and selected by deer during the fall 1984, while the other crop fields were avoided. Wetlands were used in proportion to their occurrence, and shelterbelts were again selected by deer during the fall.

DISCUSSION

Deer habitat use in eastern South Dakota is strongly influenced by seasonal changes in agricultural land use and changing climatic conditions. Deer made seasonal shifts in habitat use corresponding to changing land use conditions. Quality and quantity of food and cover provided by cropfields undergoes dramatic changes during the growing season. For example, a cornfield normally begins as bare soil in the spring which is of little value to deer, but by late summer, it has become ideal deer habitat, providing both high quality forage and cover. However, in the space of a few days after the harvest in mid to late autumn it may be transformed back to bare soil by fall plowing.

An indication of the success white-tailed deer have had in adapting to an agricultural environment, throughout the midwest, is reflected by their high rate of reproduction. In an average year, 50% or more of the female fawns and 95% of adult does breed successfully in this region (Gladfelter 1984). High productivity is the result of an abundant supply of nutritious farm crops that are available during most of the year. Corn is one of the most important food items for deer throughout the midwest (Mustard and Wright 1964, Watt et al. 1967, Pils et al. 1981). My observations indicate that when corn was available it was the most heavily used crop type on the study area. Use of cornfields began in June, as soon as the plants were tall enough to provide cover. Deer commonly used standing corn as day time bedding sites and travel lanes. Heavy use continued during the fall for bedding and travel until the fields were harvested. Deer were observed feeding in standing and picked fields from August until April. Large stubble fields were sometimes used as daytime bedding sites during the winter. Other cropfields received only limited deer use.

Pastures are important to deer during the early spring because they are one of the first areas to green-up (Murphy et al. 1985). Deer began using pastures on the study area in mid-March, which coincided with the earliest appearance of green forage. However, pastures which contained cattle were avoided. Deer used hay and alfalfa fields throughout the growing season as night time feeding and bedding sites, especially after the fields were mowed. Pils et al. (1981) reported that deer use of alfalfa in southern Wisconsin. was greatest during the spring and again in the fall until the occurrence of killing frosts. Grassy uplands in close proximity to wetlands or shelterbelts were important fawning areas during the late spring and summer. On several occasions does were observed leaving shelterbelts or wetlands and walking out to nurse fawns hidden in nearby tall grass. Survival of young fawns using idle grassland free from mowing may be enhanced compared to fawns hidden in hay or alfalfa fields. Mowing alfalfa fields in late May and early June killed an estimated 7% of the fawns born on a predominantly agricultural site in south central Wisconsin (Herron and Rongstad 1982).

Shelterbelts and farmstead woodlots played an important role in the seasonal pattern of deer habitat use in eastern South Dakota. Deer began using these habitats heavily in early spring as soon as the cover became free of drifted snow. The trees provided deer with the only cover available at this time. By late May and June, most ungrazed shelterbelts supported a heavy growth of lush vegetation, which provided pregnant does with critical fawning habitat. Use of shelterbelts decreased slightly during the summer when cropfields began to provide good cover for bedding and travel. However, once the fall harvest was underway, deer use of shelterbelts again increased. Severe snowstorms during the end of November and December, 1983, rendered most shelterbelts and woodlots inaccessible to deer because of drifting snow. An adequate diet. which deer were able to obtain from agricultural crops, may be more important than cover requirements to wintering deer in this region (Moen 1969).

Wetland vegetation composed mostly of willow shrubs, cattails (*Typha* *spp.*) and phragmites (*Phragmites communis*) provided deer with virtually the only available cover during the winter of 1983-84. Herds of 40-60 deer were commonly found bedded in or along the edges of wetlands. Value of wetlands as wintering habitat for deer should not be under estimated. The importance of wetland vegetation to wintering pheasants (*Phasianus colchincus*) was illustrated by Schneider (1985) who conducted microclimat measurements on the study area during the winter months. He reported that wetlands, because of their dense horizontal cover, reduced wind velocities an average of 95% more than nearby shelterbelts. Wetlands, in effect act as yarding areas during periods of severe winter weather.

As the weather moderated in Febuary and early March, a shift in deer use to large stubble fields and open areas which were free of human disturbance was noted. Topography in these areas was slightly rolling which allowed deer to stay out of sight from roads. Exposed portions of large fields were normally free from deep snow accumulation because of strong winds. These areas allowed deer access to waste corn throughout the winter. Similar observations on winter habitat use by deer in this area were reported by Sparrow and Springer (1970).

MANAGEMENT IMPLICATIONS

Findings from my research indicate that deer use agricultural land throughout the year. However, non-agricultural habitats may assume critical seasonal importance. My observations show that deer will utilize virtually any idle habitat for at least part of the year. Establishment of permanent cover on marginal lands, which have been taken out of production would furnish deer with needed habitat. Wooded cover in particular was heavily used by deer as long as it remained free of deep snow.

Restoration of some wetlands in heavily drained areas could help reduce landowner-deer conflicts by providing additional wintering habitat. Severe crop damage problems can occur during the winter months when deer are forced to concentrate in localized areas where there is adaquate cover. Unharvested crops left standing in the field, haystacks, and corn bins in close proximity to wintering deer concentrations can suffer heavy damage. A good dispersion of suitable wetlands could help achieve a more favorable deer distribution by keeping the animals dispersed.

Deer on the study area frequently fed in harvested corn fields during the winter. However, the amount of waste grain available to deer in the future could be severely restricted, if agricultural practices such as fall plowing became more prevalent (Nixon et al. 1970, Murphy et al. 1985). Warner et al. (1985) reported that current autumn tillage systems, such as chisel plowing or off-set discing drastically reduce the amount of waste corn or soybeans available to wildlife and may be of only marginal benifit for conserving soil. Discouraging fall tillage of stubble fields in close proximity to wintering habitat would provide deer with a valuable source of winter forage. Leaving several rows of standing corn adjacent to winter cover could also help attract deer away from haystacks or other livestock forage

CHAPTER 3

EFFECTIVENESS OF TRAIL COUNTS FOR ASSESSING WHITE-TAILED DEER HABITAT USE

An expanding white-tailed deer herd in eastern South Dakota has resulted in growing landowner complaints, because of deer crop damage. Development of reliable and economical methods to measure deer habitat use in agricultural regions would greatly benefit deer managers in their efforts to maintain deer population levels that are within the carrying capacity of available habitat, and compatible with agricultural interests.

Pellet-group counts have been widely used as a method to estimate deer or elk habitat use or preference between habitat types (Neff 1968), although the validity of this technique has been seriously questioned (Collins and Urness 1979). Deer trail counts have been reported as a technique to provide a reliable index to fall deer populations, distribution, and habitat use in forested areas of Wisconsin (McCaffery 1976, 1979; Creed et al. 1984). Habitat use was not strictly defined, although McCaffery indicated that deer trails were created in all habitats in proportion to the abundance of deer and not in relation to ground cover characteristics in the various forest types. Forest types with the highest mean number of trails were shown to contain the highest deer densities. However, the relationship between deer use of a specific habitat type and deer abundance is not entirely clear. Collins and Urness (1979), defined use as the relative time spent in various habitat segments.

This study tested the validity of using trail counts as a technique to evaluate seasonal deer use of various habitat types, on predominantly non-forested agricultural land in eastern South Dakota. Radio telemetry locations of deer were used to provide actual habitat use data for comparison with seasonal trail counts. Only trails that showed evidence of repeated use, such as well-trampled vegetation or several sets of fresh tracks were counted. Single sets of tracks were not considered to be a countable trail.

STUDY AREA AND METHODS

Seasonal trail counts were conducted on the same study area described in chapter 2. Seasonal deer habitat use data collected in 1984 and reported in chapter 2, were also used in this study to compare to seasonal trail count results.

Spring deer habitat use was determined from 80 radio locations collected from 4 does during 21 March - 18 June 1984 (Table 4). Summer use was determined from 58 locations determined for 7 does during the period 28 June - 1 August. Fall use was also determined from 7 does which yielded 46 locations during the period 21 September - 2 November. No data from radio-tagged bucks were included in the analysis because they left the study area soon after being captured. However, because the proportion of adult male deer in the population is less then 20% (Rice 1984), I felt that data obtained from the radio collared does were representative of most deer making trails on the study area.

Table 4. Seasonal habitat use by radio-tagged deer in eastern South Dakota, 21 March - 2 November 1984.

	Proportion of radio locations		
Habitat type	Spring	Summer	Fall
Crops	.237	.534	.543
Grasslands	.262	.172	.152
Shelterbelts	.362	.172	.195
Wetlands	.137	.120	.110
Total No. radio locations	80	58	46
Total No. deer tracked	4	7	7

TRAIL COUNTS

Trail counts were conducted in June, August, and October 1984. Sixteen, 2.59 square km (1 square mile) sections were sampled and 38.6 km (24 miles) of transects were covered during each count. Sections were sampled by walking transects and counting the number of deer trails that intersected each transect. Logistic considerations necessitated sampling 2 contiguous sections by a pair of observers, each sampling one of the sections. Eight pairs of sections within the study area were selected at random. Four of these pairs were randomly chosen to run the transects in a north to south direction. Transects in the other 4 pairs went in an east to west direction. Distances in tenths of a mile from 0 to 9 were randomly selected to determine the starting point along the border of each section, which was usually delineated by a section road. To sample a transect, an observer walked .8 km in the designated starting direction, then rotated 90 degrees and walked .8 km perpendicular to his starting direction and then finished the transect by again rotating 90 degrees and walking .8 km in the original direction of travel. All deer trails intersecting the transects were counted and identified to habitat type. Observers also stopped every 100 m and recorded the habitat type. Habitat data collected on the transects were used to estimate the proportions of the different habitat types available on the study area in 1984, as reported in chapter 2.

Chi-square, goodness-of-fit tests were used to compare the number of trails found in each habitat each season to an expected number of trails. The expected number of trails was determined by multipling the proportion of telemetry locations in each habitat by the total number of trails counted each season. Telemetry observations were assumed to reflect the actual deer habitat use. Tests with $P \leq 0.05$ were considered significant.

RESULTS AND DISCUSSION

Monitored deer remained dispersed across the study area throughout the the spring, summer, and fall seasons. Number of trails counted was highest during spring and then decreased during the summer and fall (Table 5). This contrasted with McCaffery (1976) who reported that periodic recounts on marked permanent transects indicated that most trails were made by deer during late summer and fall. New trails did not begin to appear on the permanent transects until August, after vegetation growth had slowed. An average of .63 trails were found per 1 km of transect walked on the study area. Small sample sizes in wetlands and shelterbelts made it neccessary to combine these habitats for statistical analysis.

During the spring season, the observed number of trails was significantly different ($P = .006$) from the expected number of trails in all habitats combined (Table 5). Grasslands were regularly used by deer for feeding and night time bedding sites, but the amount of use

Table 5. Seasonal deer trail surveys in eastern South Dakota, 1984. Chi-square values are from analysis of observed trails vs expected trails, based on the proportion of radio locations in each habitat multiplied by the total No. of trails counted each season.

Habitat type	Spring		Summer		Fall	
	Trails	Expected trails	Trails	Expected trails	Trails	Expected trails
Crops	3	7	9	12	5	12
Grasslands	20	8	6	4	11	3
Shelterbelts*	3	10	3	4	3	4
Wetlands*	3	4	4	2	3	3
Total No. trails	29		22		22	
Chi-square	9.94**		.905		7.53**	

* Shelterbelts and wetlands were combined for chi-square analysis.

** $P < 0.05$

they received as measured by the number of trails observed was greater than the relative time deer spent there. Shelterbelts provided abundant cover during the spring and were heavily used by deer for bedding and travel. Normally only 1 or 2 well used deer trails ran down the center of these areas between the rows of trees. The relatively low number of trails counted did not accurately reflect the frequent deer use of these habitats.

During the summer trail counts, which were conducted from 2 August to 6 August, 22 trails were counted. No significant difference (P = .635) was detected between the observed number of trails and the number of trails expected. Moist soil conditions caused by frequent rain aided the ability of observers to detect trails in crop fields which received frequent deer use. Smaller numbers of trails counted in other habitats reflected the limited deer use these areas received during the summer season.

Fall trail counts were conducted during 31 October - 7 November. Only 22 trails were counted. The number of trails observed in the different habitats were significantly different (P = .023) from expectations. McCaffery (1976,1979) reported the optimal time to conduct trails counts was in the fall after a hard frost but before snow accumulation, or in the spring before green up, because almost no change in the location or number of trails occurred over winter. His findings indicated that if a killing frost did not occur before 20 October, the ability of observers to detect trails was diminished and subsequent counts did not accurately reflect deer abundance. Trail visibility should be greatest in dead or dormant vegetation after leaf fall. In agricultural areas of eastern South Dakota leaf litter has relatively little impact on trail visibility. However, dead or dormant vegetation in wetlands and grasslands could be expected to enhance trail formation.

A hard freeze occurred on the study area during the night of 25 September, indicating that proper environmental conditions prevailed at the time of the fall trail counts. Relatively few trails were found in crop fields, which were heavily used by deer during the fall season. In agricultural states such as South Dakota the optimal time for trail surveys coincides with peak corn and soybean harvesting activity. In some instances trails were destroyed by plowing and heavy harvesting equipment. In other crop fields dry hard packed, bare soil and lack of adequate ground cover may simply have prevented visible trails from forming. Other habitats such as idle grasslands may serve as travel lanes between bedding cover and crop fields. Regular travel across these areas apparently produced large numbers of trails which were out of proportion to the relative amount of time deer spent there.

Findings from this study suggest that in many instances deer trail counts do not accurately reflect deer habitat use in agricultural areas of eastern South Dakota as measured by the relative time spent in a specific habitat type. The use of trail counts to measure deer habitat use in other regions should be investigated further.

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APPENDICES

Appendix A. Record of 18 white-tailed deer fitted with radio transmitters in east-central South Dakota, 1983-1984.

ID No.	Sex	Date radiod	Date of last transmission	Reason
039	F	02/83	11/02/84	Study ended
100	F	02/83	10/05/83	Harvested by hunter 10/13/83
140	F	02/83	01/13/84	Died of unknown causes 01/18/84
083	M	06/26/83	07/06/83	Unknown
240	F	06/30/83	11/02/84	Study ended
199	F	07/01/83	01/13/84	Unknown
179	F	07/07/83	11/14/84	Harvested by hunter 11/28/83
340	F	07/08/83	11/02/84	Study ended
290	F	07/12/83	11/02/84	Study ended
570	F	07/20/83	10/14/83	Harvested by hunter 11/26/83
894	M	07/27/83	07/29/83	Unknown
195	M	02/29/84	03/22/83	Transmitter failure, harvested by hunter 11/19/84
964	M	05/18/84	05/24/84	Left area, harvested by hunter 11/03/84
420	F	05/20/84	05/24/84	Left area, harvested by hunter 11/19/84
020	F	07/17/84	10/30/84	Study ended
520	F	07/20/84	10/26/84	Study ended
460	F	07/20/84	11/02/84	Study ended
575	F	09/20/84	09/25/84	Transmitter failure